



E-mail as a way of communication during the ACWY meningococcal vaccination campaign in adolescents and young adults in the Region of Murcia

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ABSTRACT

In 2019, ACWY meningococcal vaccination for people born between 2001 and 2007 was recommended. In Murcia, during the first 9 months, the coverage was 52.89%. This study is aimed to evaluate the effects of e-mail reminders on vaccination coverage.

A longitudinal, prospective trial was performed on non-vaccinated individuals with e-mail addresses. An e-mail reminder was sent to people assigned to the intervention group (born in any month, except January and July), and 4 weeks later, the same was sent to the control group. Vaccination coverage was assessed before and 4 weeks after each intervention.

After the first intervention, 5.15% of the participants in the intervention group were vaccinated (1.57% in the control group). The increased likelihood of being vaccinated if a person had been sent an e-mail was 1.033 (95% confidence interval, 1.019–1.047; $p = 0.001$).

This study highlighted the impact of e-mail as an appropriate method of communication for vaccination programmes.

1. Introduction

Although invasive meningococcal disease (IMD) in Spain is relatively rare, cases of this disease by serogroups W (incidence rate from 0.01/100.000 inhabitants in the 2013–2014 season to 0.10/100.000 in the 2017–2018 season) and Y (incidence rate from 0.01/100.000 inhabitants in the 2013–2014 season to 0.08/100.000 in the 2017–2018 season) have increased since 2014 [1]. Since 2009, a first increased incidence was observed in the United Kingdom owing to *Neisseria meningitidis* serogroup W (strain cc11) [2], with an incidence ratio of 1.8 (95% confidence interval [CI]: 1.2–2.8) between the 2011–2012 and 2012–2013 seasons in England, and 5.2 (95% CI: 2–13.5) between the 2014–2015 and 2015–2016 seasons in the Netherlands [3,4].

Considering meningococcal transmission, the epidemiological background of IMD in close countries, the increase in its incidence in previous years in Spain, and current knowledge on conjugate vaccine's effectiveness, and lingering protection, the Spanish Public Health Commission approved the recommendation of changing adolescent vaccination (11–12 years of age) from serogroup C to ACWY in March 2019, and a meningococcal ACWY (MenACWY) vaccine catch-up was recommended for people born between 2001 and 2007 (up to 18 years old) [5].

In Murcia, meningococcal vaccination was changed, for children born in 2008 during the 2019–2020 school season. Nevertheless, the MenACWY vaccination campaign planned for people born between 2001 and 2007 for March 2020 had to be postponed because of the

Abbreviations: CI, confidence index; COVID-19, coronavirus disease 2019; IMD, invasive meningococcal disease; MenACWY, meningococcal ACWY; MVP, mass vaccination point.

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coronavirus disease 2019 (COVID-19) pandemic.

In the second fortnight of September 2021, the last day of COVID-19 mass vaccination point (MVP), a massive vaccination campaign was developed [6]. Appointments can be made online, by phone, or in person at health centre. In addition, anyone from this age group who went to MVP in the weeks prior to COVID-19 vaccination was offered an appointment for MenACWY vaccination. People may go to the MVPs without previous appointments on some days. In this two-week massive vaccination programme, a total of 55,879 doses were administered, with a coverage of 39.8% of the target population. After 8 more months of vaccination through primary care centres and regular vaccination points without any active recruitment, the coverage increased to 52.89%. To increase vaccination coverage and achieve herd protection, active recruitment was conducted by e-mail instead of the classic letter used previously.

Active uptake strategies to be adopted by public health vaccination programmes should be different in childhood and adolescent vaccination, in which the population that should be informed/reminded are the children's parents if the person is aged <18 years, compared to than in young adult vaccination, in which the information or reminder is addressed directly to the person to be vaccinated.

Based on the available bibliography [7] greater burden of evidence on the accessibility and low cost of the proposed intervention is observed, considering that these methods are not yet generally used as reminder methods in Spain, and that it was a reminder system used when more than a half of the population had already been vaccinated. This highlights the difficulty of recruiting a population not yet captured and allows evaluating the usefulness of the strategy as a complementary method. This study aimed to determine whether sending an e-mail as a vaccination reminder could increase MenACWY vaccine coverage for people born between 2001 and 2007. Moreover, whether an e-mail reminder was more effective than no intervention in the control group after 4 weeks was determined.

2. Methods

We performed a longitudinal, prospective interventional trial of e-mail reminders versus controls without any intervention to assess its impact on MenACWY vaccine coverage among the target population of the campaign in Murcia. The inclusion criteria for this study were birth between 2001 and 2007 with an e-mail address in the population database file at the beginning of the study (10.18% of this population) and without previous MenACWY vaccination at the age of ≥ 10 years on 10th June 2022. People without a valid e-mail at the beginning of the study were excluded for this study and were recruited afterwards for the campaign with another type of reminder.

Considering the need to vaccinate as many people as possible among the study population to assess the impact of the intervention, only one-sixth of the sample (those born in the months of January and July of each year) was assigned to the control group. Meanwhile, people born in any of the other months were assigned to the intervention group.

At the beginning of the study, participants in the intervention group received an e-mail regarding the campaign from the Vaccination Programme, informing them that they should schedule an appointment at their regular vaccination points, and providing them a link regarding the campaign (https://www.murciasalud.es/web/vacunacion/-/meningococo-acwy-1?redirect=%2Fweb%2Fvacunacion%2Fcampanas-de-vacunacion-activas-por-enfermedad%2F-%2Fcategorias%2F5481553%3Fp_r_p_categoryId%3D5481553). Four weeks after the e-mail was sent to the intervention group, the same text was sent to the control group. The effect of the intervention was evaluated 4 weeks after each intervention.

The collected variables included vaccination coverage (birth cohort and sex, which were obtain from the Vaccination Registry Information System, called VACUSAN), and age depending on the birth cohort and sex. VACUSAN does not collect variables such as ethnicity or socioeconomic status.

Statistical analyses were performed using SPSS version 25.0. Vaccination coverage was calculated as the percentage of vaccinated individuals divided by the number of vaccine candidates among those who had an e-mail address. Data are described as frequencies and percentages for vaccination coverage (qualitative variables) and as means and standard deviations for age (quantitative variables). Chi-square test was used to compare the frequency distributions of the data. Student's *t*-test was used to compare the mean of the data. Significance was set at $p < 0.05$ for all analyses.

The ethical aspects of the research were in accordance with the provisions of the Declaration of Helsinki of the World Medical Association on Ethical Principles for Medical Research Involving Human Beings and its subsequent amendments. The data were treated confidentially, in accordance with Spanish law.

3. Results

In June 13, the e-mail was sent to 2,647 people, as the first part of the intervention; however, 85 e-mails were returned (Fig. 1). Four weeks after the intervention, the vaccine coverage was calculated for both groups. After this, on July 4, the same intervention was performed for the control group (521 people were sent the e-mail and 11 were returned) with a new coverage calculation 4 weeks after the second stage. Finally, the total population was 3,072 people (demographical data are presented in Table 1).

The vaccination coverage 4 weeks after the first intervention and the percentage of vaccinated people after the second intervention for each group are presented in Table 2. After the first intervention, 5.15% of people in the intervention group were vaccinated versus 1.57% of people in the control group, indicating an increased likelihood of being vaccinated if the person had been sent an e-mail (1.033; 95% CI, 1.019–1.047; $p=0.001$).

The final vaccination coverage for the study's population was 6.90% (212 of 3,072 people vaccinated after both interventions were performed). No significant differences were detected in vaccination coverage after both interventions with respect to age (<18 years or ≥ 18 years), (Table 3) or sex. However, significant differences after the first intervention were detected between the participants in the intervention and control groups, depending on whether they were stratified in the order of being aged <18 years or ≥ 18 years.

4. Discussion

Optimal meningococcal vaccination coverage in adolescents and young adults in Murcia, as demonstrated in countries similar to ours [8,9,10], is far from being achieved [11], which leads us to seek new strategies to reach this population group. Evidence that reminders have proven successful in improving vaccination rates is strong [12,13]. Electronic interventions can help people change their behaviour as part of a health programme [14,15]. A review of 29 studies through 2012 by the Centers for Disease Control and Prevention Community Preventive Services Task Force [16] has reported an increase in vaccination rates similar to ours when using reminder/recall strategies alone. A Cochrane systematic review [17] that compared mail and telephone reminders with no intervention revealed an increased likelihood of 1.36 (95% CI, 1.020–1.53), favouring reminders for adolescent immunisation.

Morris et al. compared the preferences of 5,050 adolescents in San Diego regarding the manner in which reminders were made [18]. Participants who received reminders were more likely to become up-to-date (24.6% versus 12.4%; $p < 0.001$) than those in the enrolment phone call-only group. It is important to consider that other studies that compared different reminder strategies were performed with people without previous vaccination opportunities, in contrast to ours. Our study was performed as an uptake with those people not vaccinated after vaccination in the MVP and after 8 months of vaccination without any active recruitment strategy, which indicates that this type of reminder works

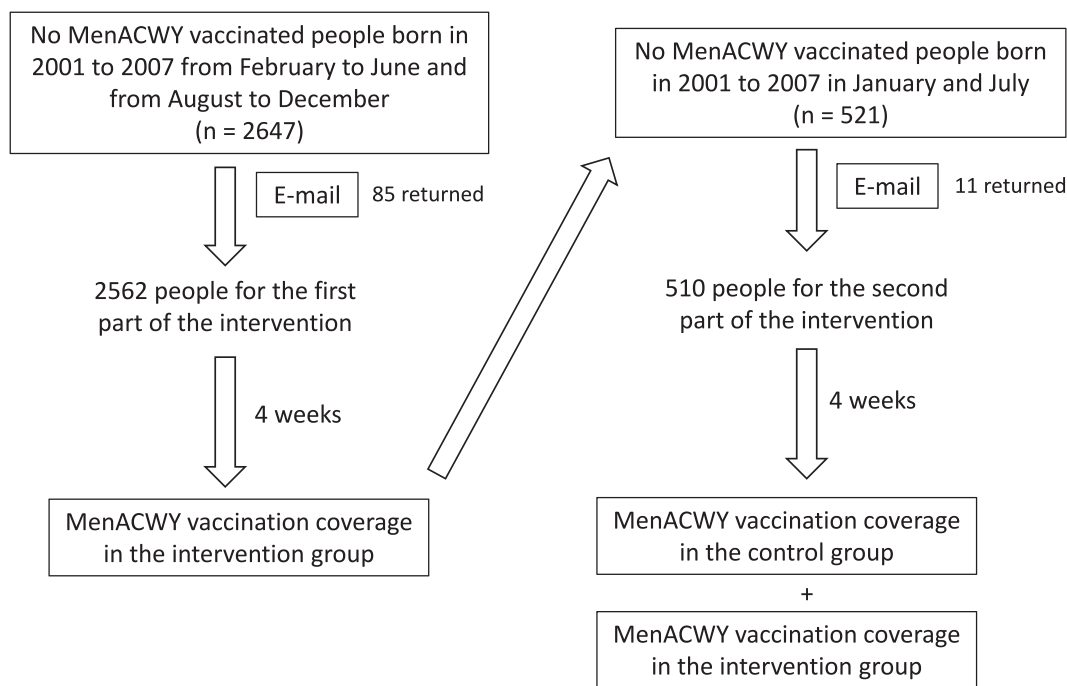


Fig. 1. Development of the different stages of the intervention performed in people with an e-mail address in their VACUSAN file.

Table 1 Demographical data of the population.

	INTERVENTION GROUP	CONTROL GROUP	p
Age in years (mean, SD)	19.36 (1.57)	19.28 (1.66)	0.257
<18 years/≥18 years (n, %)	355 (13.88%)/2207 (86.12%)	77 (15.16%)/433 (84.84%)	0.244
Sex (male/female) (n, %)	1,191 (46.50%)/1371 (53.50%)	246 (48.35%)/264 (51.65%)	0.443

Table 2 Vaccination coverage in each group after each part of the intervention.

	INTERVENTION GROUP	CONTROL GROUP	p
People vaccinated 4 weeks after e-mail sent to intervention group (n, %)	132 (5.15%)	8 (1.57%)	0.001
People vaccinated 4 weeks after e-mail sent to control group (n, %)	180 (7.02%)	32 (6.14%)	0.508

Table 3 Vaccination coverages after each interventions in each age group.

	INTERVENTION GROUP	CONTROL GROUP	p
Younger than 18 years old	Vaccination coverage after first intervention		0.001
	9.01%	3.89%	
18 years or older	Vaccination coverage after both interventions		0.001
	3.39%	0.06%	
Younger than 18 years old	Vaccination coverage after first intervention		0.425
	8.89%	9.46%	
18 years or older	Vaccination coverage after both interventions		0.230
	6.71%	5.73%	

even in populations with greater difficulty in vaccination.

A systematic review of 11 studies (90% with experimental study designs) by Frascella et al. evaluated the effectiveness of e-mail reminders in increasing vaccine uptake [7]. Although e-mail communication succeeds in increasing vaccine uptake compared with no

intervention, weak and heterogeneous data exist, supporting the superiority of e-mail reminders over, traditional methods or other digital reminders. Nevertheless, they concluded the need for further research to prove the impact of e-mail communication on vaccine uptake in different settings and to identify how to best integrate e-mail communication into vaccine delivery, equipping immunisation programs with technical infrastructure and normative frameworks suitable to embrace innovation. Considering the small number of non-vaccinated people with e-mail addresses, e-mail reminder were not compared with other forms of recruitment, such as letters or text messages.

Among all the people born between 2001 and 2007 in Murcia with an e-mail registered in the population database (10,799), 7,452 were vaccinated prior to intervention (69.00%). After both parts of the intervention, the number of vaccinated people with e-mail addresses ascended to 7,664 (70.96%). The population with e-mails in our database had greater coverage than the regional average, which increased the degree of difficulty. However, the vaccination coverage of the population contacted by e-mail in this active recruitment increased to 6.90%, which indicates an increase of nearly 2% from the total number of people with e-mail in the database, without the costs that imply postal reminders, the regular notification method, so its efficiency is high.

This study had limitations. As the VACUSAN does not collect variables such as ethnicity or socioeconomic level, analysing the relationship between these variables, which could influence vaccination coverages, was not possible. Moreover, determining the percentage of people who read the e-mail was not possible, since marking an e-mail opening notification would saturate the e-mail account, or the number of people who did not read it because it went to the spam folder. Determining this number would be beneficial for identifying the real number of e-mail recipients, which would lead to greater coverage

among the people who actually received intervention. However, neither of the two questions would influence the study because it involved comparing an intervention group with a control group. Although randomisation was not conducted, selection by birth month indicates that other variables that could influence our results are distributed similarly between those born in one month and another. Therefore, the only real difference in both groups is precisely the intervention, that is, the sending of the e-mail. Thus, the different variables should not influence our results.

Based on these findings, the Region of Murcia Vaccination Programme has begun to use e-mail regularly as a means of notifying people for different vaccination campaigns (influenza, herpes zoster, or pneumococcus) and as a valid strategy to increase vaccination coverage in both children and adults. This limitation on reading confirmation suggests the need for us to develop a new notification system for our database.

5. Conclusions

This research highlights the impact of e-mail as an appropriate means of communication and reminders on health programmes, such as vaccination programmes. Moreover, adolescents and young adults with lower risk perception, generally need to improve their overall immunisation rates. Despite a lower added cost compared to other types of vaccination reminders, e-mail could be a more effective means of communication with parents of adolescents or young adults.

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CRedit authorship contribution statement

Matilde Zornoza Moreno: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Validation, Visualization, Writing – original draft, Writing – review & editing. **Francisca Isabel Tornel Minarro:** Conceptualization, Data curation, Investigation, Methodology, Validation, Writing – original draft, Writing – review & editing. **Jaime Jesus Perez Martin:** Conceptualization, Formal analysis, Funding acquisition, Investigation, Project administration, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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